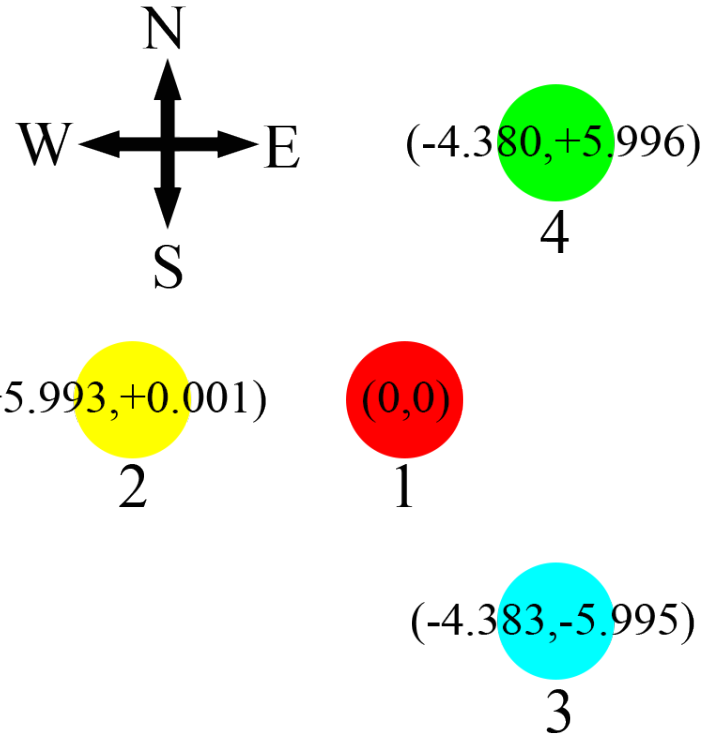
PAON4
7 scans map

Qizhi huang

11 Feb. 2016

PAON4 geometry



Gain G_i

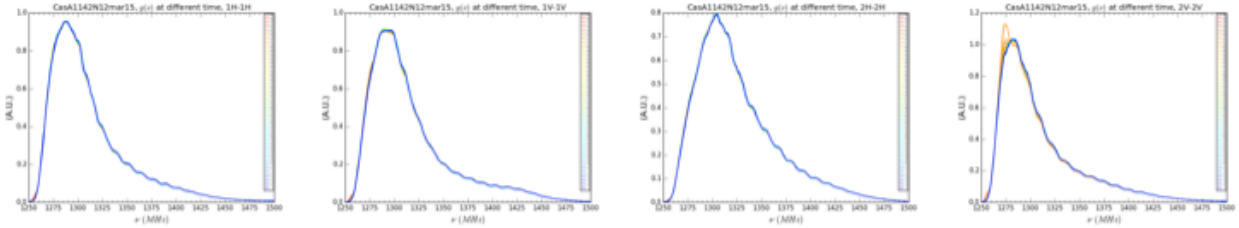
- We assume that the gain can be divide in to two part, one changes with frequency, the other changes with time：

$$G(t,\nu) = G(t) \cdot G(\nu)$$

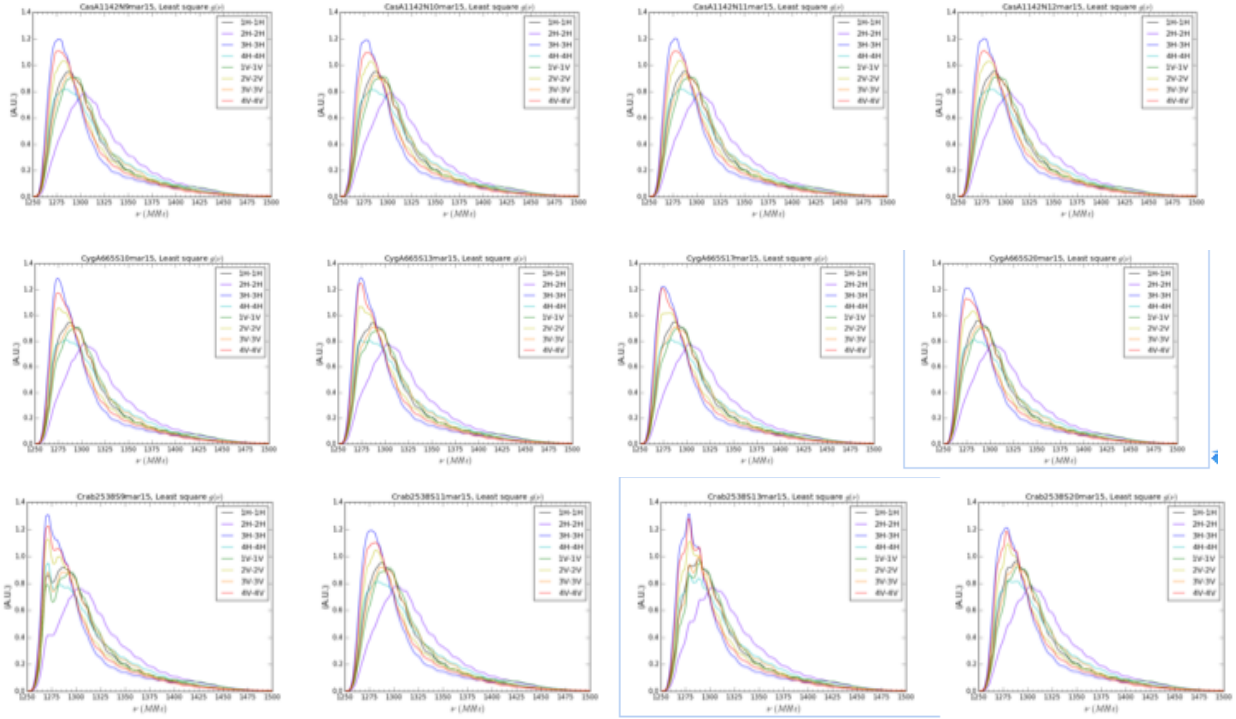
- We study $G(\nu)$ and $G(t)$ using the auto-correlation.
- $G(\nu)$: assume in a small time interval, $G(t)$ changes a little, then we can get the $G(\nu)$ in this interval by summing/averaging the data.
- $G(t)$: the noise in the data is scaled by the gain $N_{obs} = G \cdot N_0$, if we assume the noise/system temperature is stable, then we can trace $G(t)$ by the standard deviation

Calibrate gain 1: $G(\nu)$

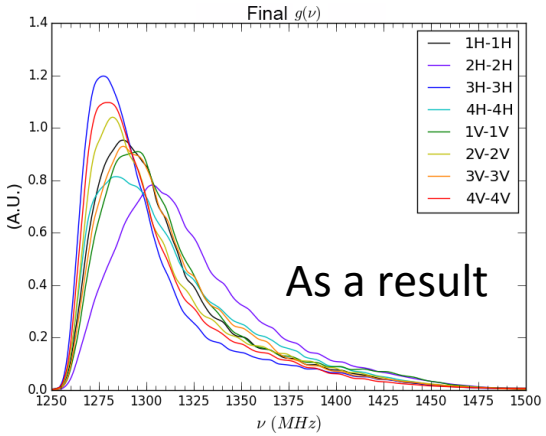
- I calculate the $G(\nu)$ every 5 minutes. Below shows $G(\nu)$ in each data set, we can find that it's stable in one day.



- Below show the $G(\nu)$ in different days and on different sources, it seems stable.

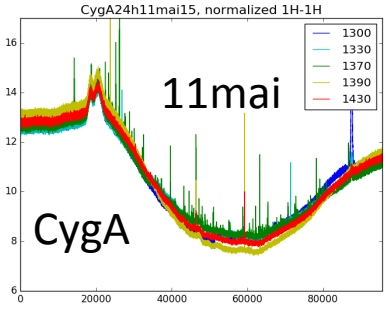


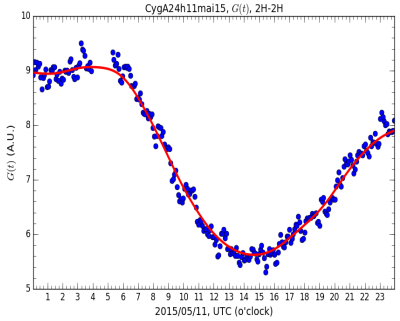
There are dozens of figures, here I just show some of them

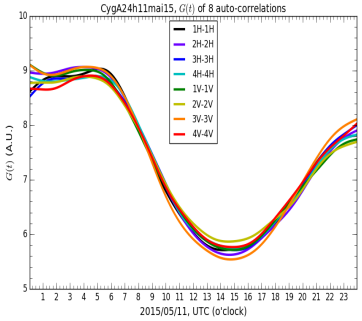


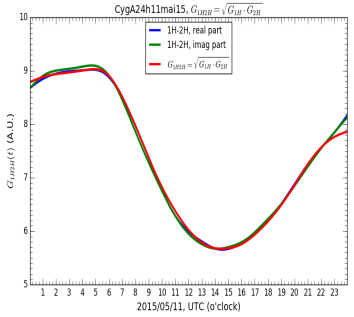
Calibrate gain 2: $G(t)$

- $G(t)$ will affect the profile of the data along times axis significantly.
- When fit the fringes and make the sky map, we must calibrate $G(t)$ carefully.







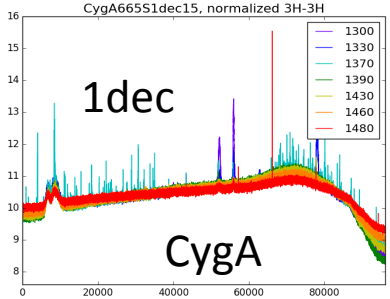


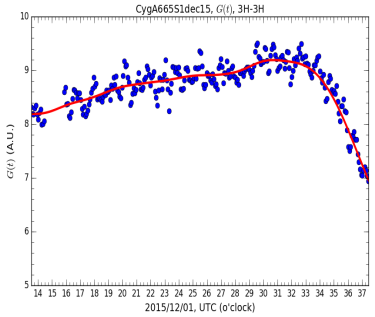
Auto-correlation with RFI(mask them when calculate std)

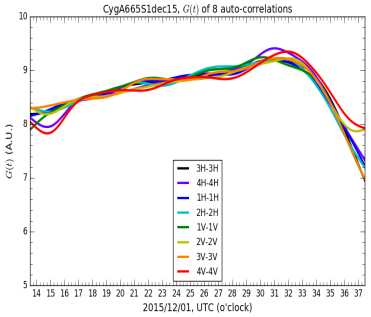
blue point is from std of data

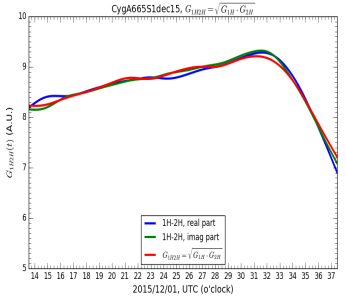
get the smoothing curve from the blue points

check Gij=(Gi*Gj)^0.5









There are dozens of figures, here I just show some of them

Calibrate phase 1: fit fringe

- After calibrating the gain, we can calibrate the phase by fitting the fringe.
- We can see that the phase changes linear with the frequency, then we can fit the linear formula.
- Here I also compare the old data in March and new data in December. something has changed, one thing is the channel to antenna:
- Old data: March ~ August
- New data: November ~ December
- We can find that the phases have changed (use the same method to fit them)
- → Discuss the reasons?

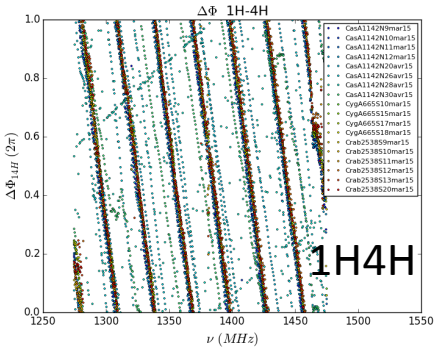
- For old data:
- ch1->1H, ch2->2H, ch3->3H, ch4->4H
- ch5->1V, ch6->2V, ch7->3V, ch4->4V

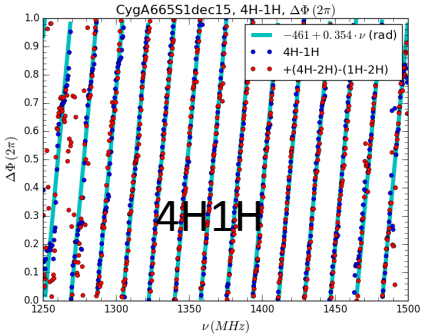
- For new data:
- ch1->3H, ch2->4H, ch3->1H, ch4->2H
- ch5->1V, ch6->2V, ch7->3V, ch4->4V

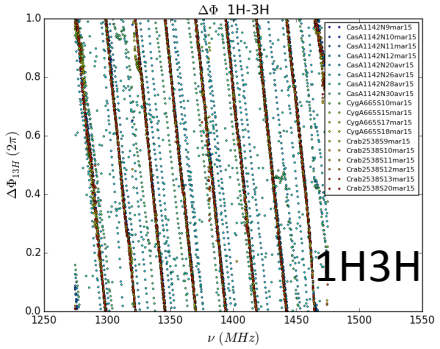
Here I also check the relationship between the phase

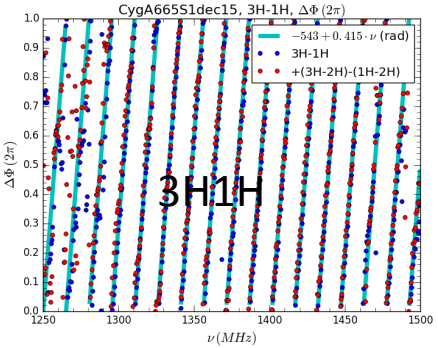
$$\Delta\Phi_{ij} = \Delta\Phi_{ik} + \Delta\Phi_{kj} = \Delta\Phi_{ik} - \Delta\Phi_{jk} = \Delta\Phi_{kj} - \Delta\Phi_{ki}$$

and also fit the phase as linear(cyan line)

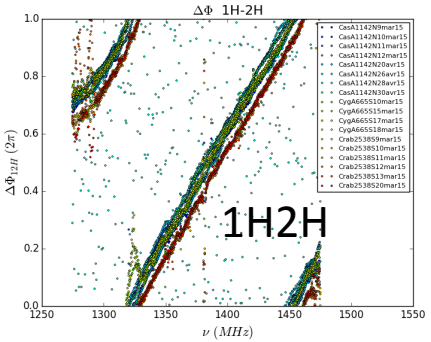


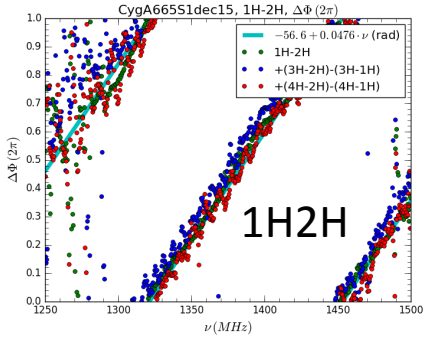


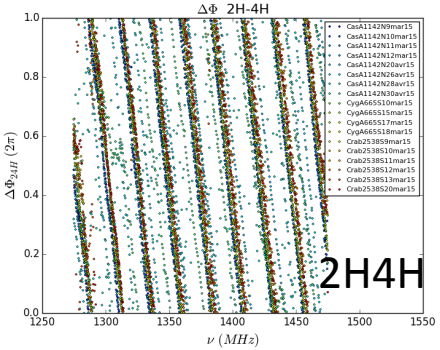


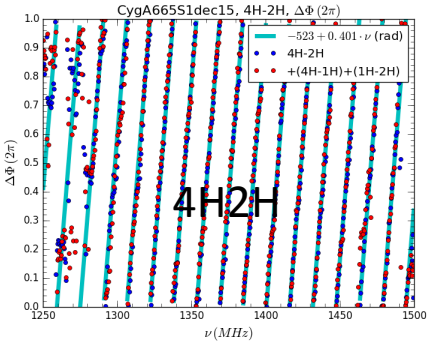


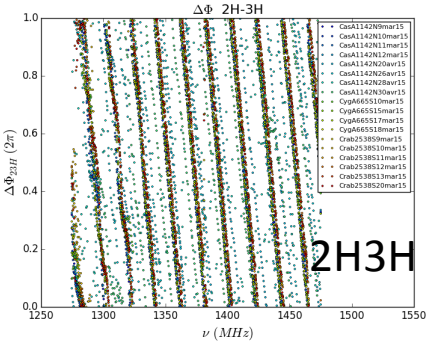
slope

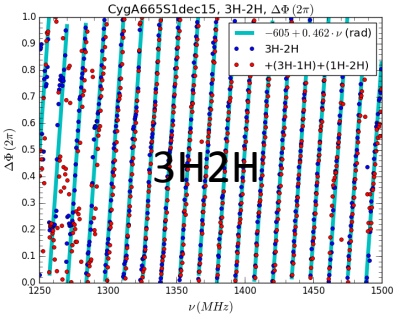










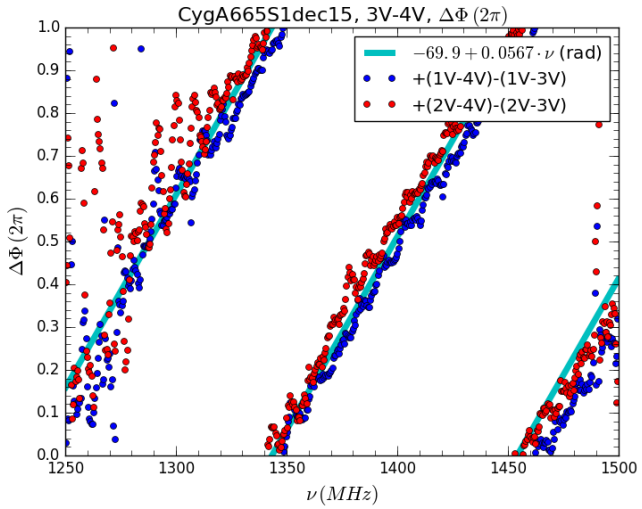


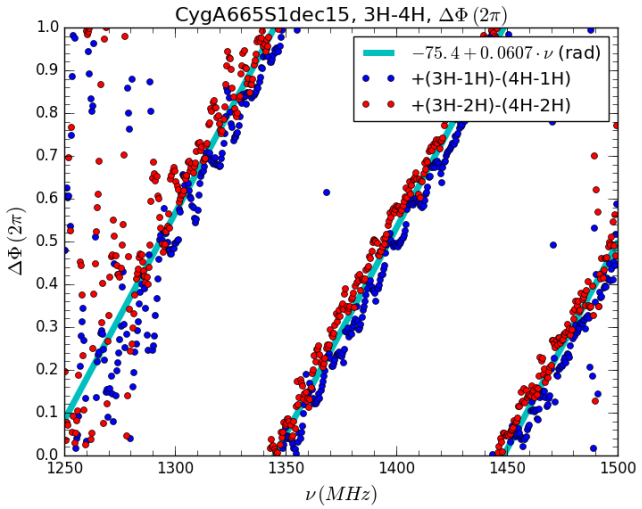
Calibrate phase 2: predict phase_{3-4}

- For antenna 3 and 4, the Lew~0, we can't see the fringe and difficult to get the phase_{3-4}.
- However, we can use the relationship

3H4H = 3H1H – 4H1H = 3H2H – 4H2H to predict it.

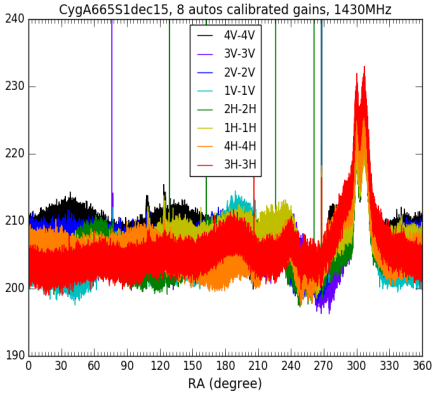
This relationship is checked above and seem to be reasonable.



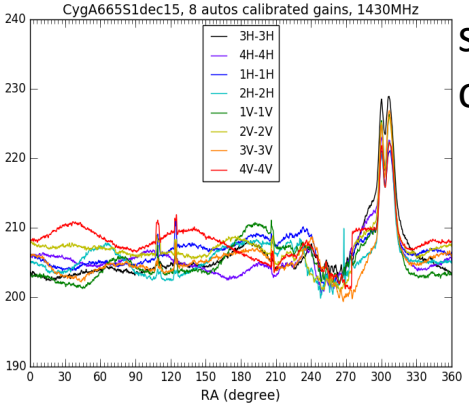


Auto correlations

- After calibrate the gain, all 8 auto-correlations should be more or less the same because they are the power of the sky(assume the system temperature is stable).
- Below We can see 8 auto-correlations are not the same. One reason is that the gain is not calibrated well, the other reason may be the electric system effect.
- In order to convert the observation time to RA, I use the sidereal time that the source reaches the local meridiem. We need to use the RA, Dec of the source and the longitude of the antenna.

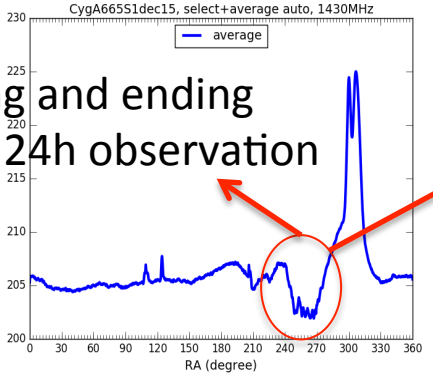


8 auto-correaltions with noise and RFI



Remove RFI, and smooth the data to low down the noise

starting and ending of the 24h observation



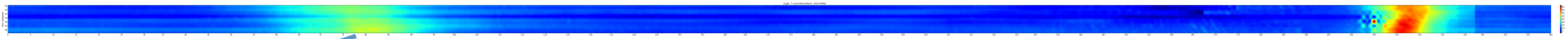
Because of the uncertain/bad edge of G(t)

The auto-correlationof 2H, 1V, 4V are not good, I throw them, and average the rest

Make map

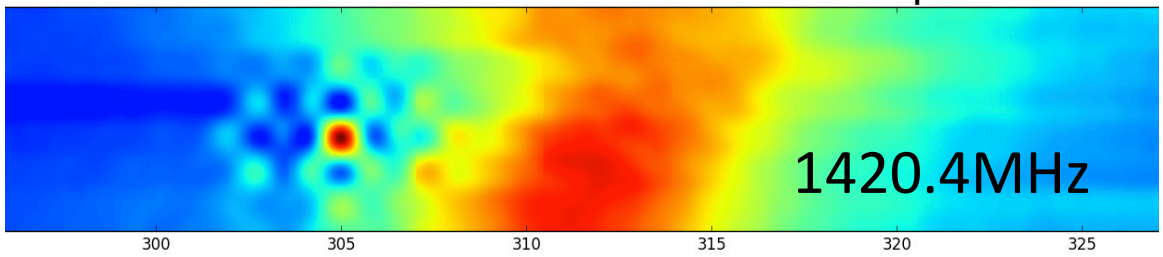
I use 7 scans to make this map.
For each scan, I get 200 mock lines by add a phase exp(i*2pi/l*Lns*sin(delta)), delta=1 degree for 200 pixel.

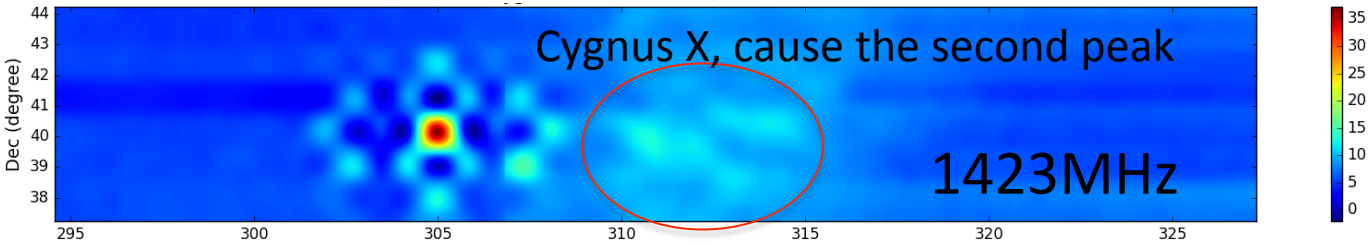
7dx360d, 1420.4MHz (you also find the large image in .jpe)



Anti Galactic center

Zoon in the region around CygA @ 1420.4MHz
The structure of HI on the Galactic plan is similar that of LAB





Strange part on auto-correlations affects the map significant (Discuss this problem on data)